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The role of farming and rural development as central to our diets

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ABSTRACT

Farming and rural development are central to the diversity of global food systems and diets, both significant factors in determining the nutrition and health outcomes of the world's population. Diets are not static and indeed are changing due to globalization, urbanization and demographic shifts. In addition, multiple burdens of malnutrition (both undernutrition and overweight and obesity) are not improving fast enough and in some cases, reversing for the worse. Unhealthy diets are major contributors to these burdens. Rural people and particularly smallholder farmers, are critical in delivering the key nutrients in the global food supply that make up our diets for human health. However, rural populations in some parts of the world are often poor, and suffer burdens of malnutrition on both ends of the spectrum – undernourished or overweight. They are also faced with significant challenges, often due to poor investment towards rural development. Challenges include natural resource declines, climate change risk, women disempowerment, conflict, and urbanization; which wreak havoc on these populations. If actions are not taken and their livelihoods are not prioritized, it will be a challenge to achieve sustainable development in these rural places that are so essential for future food systems.

1. Introduction

For most of the global population, farming is or was an integral part of our culture and heritage. Almost every society's history involves agrarian societies, made up of farmer families, pastoralists, and fisher folk, domesticating plants and animals, in which agriculture became the foundation of all economies [1]. Some countries have gone through significant structural transformations in their agriculture sector, but also in their manufacturing and service industries, allowing for economies to grow and thrive across multiple dimensions. However, other countries are still very much agrarian, and in some cases, a quilt of smallholder farms in which the agriculture sector has not yet led to significant growth for the said countries.

When thinking about a food system – food moving from production to markets and the many steps in between including storage, transport and distribution, processing and packaging – it all starts at the landscape level and with farmers. Yet, without agriculture, farms and farmers, we would not have the diverse landscapes, food baskets and diets that the world is fortunate to benefit from [2].

2. How are global diets fairing?

The biodiversity of plants and animals, and the decisions that farmers make on which species and varieties to produce, leads to the types of diets that we consume. Diets comprise the foods that an individual consumes that meet energy needs, provide the diversity of foods to meet nutritional needs, be affordable, accessible and culturally appropriate, and be safe for consumption [3]. Dietary patterns are the quantities, and combinations of different foods and beverages in diets and the frequency of how they are habitually consumed [3]. However, some basic principles can be applied that define “healthy” diets. The International Conference on Nutrition Rome Declaration states, “nutrition improvement requires healthy, balanced, diversified diets, including traditional diets where appropriate, meeting nutrient requirements of all age groups and all groups with special nutrition needs, while avoiding the excessive intake of saturated fat, sugars and sodium, and virtually eliminating trans fats, among others” [4].

However, one of the major causes of malnutrition and its subsequent health outcomes is diets. Unhealthy diets are now the number one risk factor globally for deaths and disability-adjusted life-years lost [5]. Typically, unhealthy diets are those low in fruits, vegetables, whole grains, nuts and seeds, dairy (high in calcium), fiber, seafood and fish (high in omega-3 fatty acids), and polyunsaturated fatty acids. At the same time, these diets can be high in red meat, processed meat (smoked, cured, salted, or chemically preserved), sugar-sweetened beverages, trans fats, and highly-processed food consumption [5]. Highly-processed foods are usually characteristically high in salt, trans fats and added sugar [6,7].

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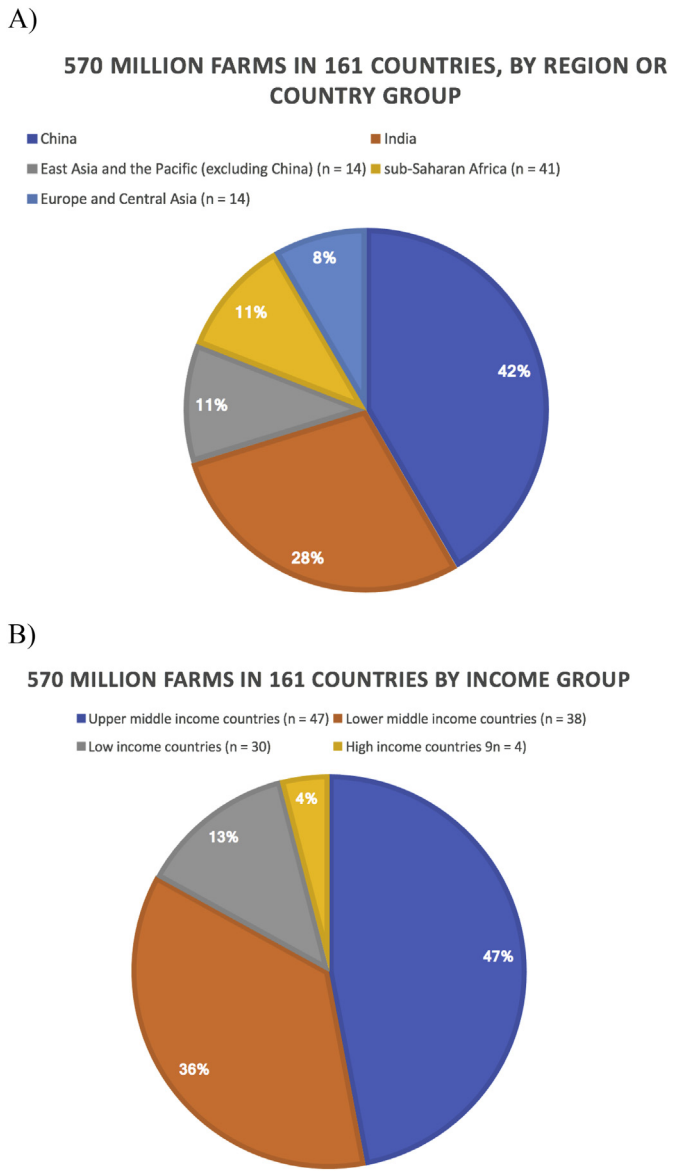

Fig. 1. Estimated number of farms in the world by regions and by county wealth category. Legend: (A) Number of farms by Region or Country Group. (B) Number of Farms by Income Group.

What we are left with is a massive burden of malnutrition. At the global level, food systems produce enough food, yet malnutrition exists in almost every country with some countries reeling from multiple burdens that are complex to tackle [8]. Approximately 850 million people are still undernourished, 155 million children under five years of age are stunted; and 52 million are wasted [9,10]. Micronutrient deficiencies (iron, zinc, vitamin A, iodine, folate, etc.) are still a major public health concern. At the same time, overweight and obesity has more than doubled since 1980. A staggering 2.1 billion adults are overweight or obese [11]. An estimated 41 million children under five were overweight, a quarter living in Africa and almost half in Asia [10].

3. Who is delivering our diets?

Farms and farmers produce the food that serves as the basis of our diets. The total number of farms in the world is now estimated to be > 570 million taken from World Census of Agriculture data from 1960 to 2010 [12]. These data come from 167 countries, 96% of the world's population, 97% of the population active in agriculture, and 90% of agricultural land worldwide [12,13]. As Fig. 1 shows, most of the farms are found in upper- and lower-middle income countries with China and India making up roughly 60% of the farms in the world. Many of these farms are considered small-scale and are family farms.

Smallholder farms are usually defined by land size, but some countries also consider the number of livestock held, the assets used, or gross sales coming from individual farms. The most commonly used thresholds for designating small farms are one and two hectares, recognizing that farms below this threshold include a very diverse range of enterprises [13]. Of farms worldwide, 84% are smaller than 2 ha (approximately 475 million farms), but only operate 12% of all farmland. According to FAO [14], smallholders can be small-scale farmers, pastoralists, forest keepers, fishers who manage areas varying from < 1 to 10 ha.

Of those farms that are considered small-scale, approximately ~3.4 billion people currently live and work on those farms across the developing world [15]. Eighty percent of the farmland in sub-Saharan Africa and Asia is managed by smallholders working on up to 10 ha and these smallholders provide 80% of the food supply in Asian and sub-Saharan Africa. Whereas in Australia, Latin America and North America, food coming from rural places are from medium to large holdings [16].

When it comes to “family farms,” there are two criteria that are common in defining what consists of the “family” aspect of farms: The first criteria is that someone in the household owns, operates and/or manages the farm; and second, a “minimum share of labor” comes from the owner and relatives [13,17]. > 98% of the farms are characterized as family farms and they operate at least 58% of the agricultural land. It is estimated that family farms in sub-Saharan Africa and Asia that meet 36–114% of the domestic caloric requirements [17].

Agriculture employs 1.3 billion people globally, or close to 40% of the global workforce [18]. In low-income countries, agriculture employs up to 75% of the population [13]. Women comprise 45% of the agricultural labor force of developing countries up to almost 50% in Eastern and Southeastern Asia and sub-Saharan Africa [19]. Agriculture-led growth and agriculture-based solutions can make important contributions to reduce undernutrition [20], as well as to dietary diversity, micronutrient sufficiency and nutritional status [21]. Agricultural productivity is fundamental for sustaining the nutritional and health status of billions of people, ensuring food security, and generating the resources to access adequate care, health, water, and sanitation services [22]. The interactions among health, nutrition and agriculture are mutual: agriculture affects health and health affects agriculture—both positively and negatively [23].

4. What are farms providing?

Farms are made up of landscapes, and these landscapes can be rich in biodiversity and ecosystem services. Farms can also be less diverse such as the case with mono-cropping systems. Biodiversity richness, and in the context of agriculture and farming systems agrobiodiversity, are important in maintaining the diversity of foods that make up our dietary patterns. Smallholder farming systems and landscapes are particularly diverse. Herrero et al., [16] show that globally, diversity of agricultural and nutrient production diminishes as farm size increases and smaller landscapes with more agrobiodiversity provide more nutrients into the global food supply, particularly micronutrients (53 to 81% of micronutrients in the food supply) [16]. Fig. 2 shows the most critical nutrients for human health, by region and size of farms and the species richness of smallholder farms in different regions.

Several studies have attempted to better understand the linkages between smallholder farmer production and dietary diversity in traditional systems – such as rural places, or less formal food systems. Both on-farm production and the diversity of that production as well as access to markets are essential for the diets of smallholder farmer families. Studies demonstrate the significance of homestead production and its

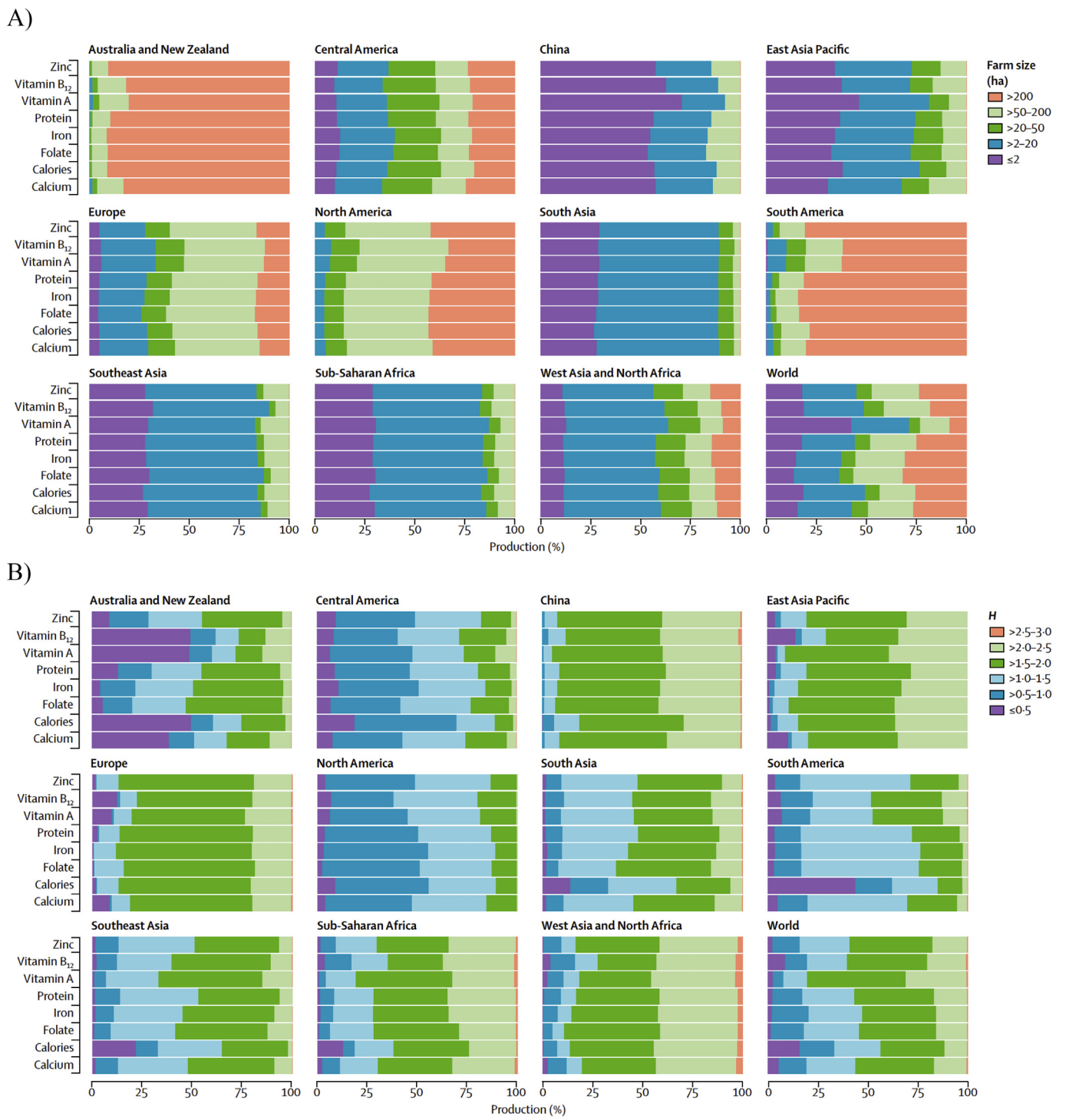

Fig. 2. Nutrients produced by farm size and by regions. Legend: (A) Distribution of nutrients by farm size. Very small < 2 ha; small 2–20 ha; medium 20–50 ha; large 50–200 ha; very large > 200 ha. (B) Diversity is represented by the Shannon diversity index, *H*, which represents how many different types of foods are produced in a pixel and how evenly these different types are distributed. The higher the Shannon index, the higher the diversity.
Source: Herrero et al. [16].

diversity and market transactions for diets in Ethiopia, Indonesia, Kenya and Malawi [24–28]. Food-based agriculture solutions to increase dietary diversity and in some cases, nutritional status outcomes such as child growth, include intercropping and integrated mixed landscapes [29], irrigation strategies [30], forest landscapes [31,32], aquaculture [33], and animal production systems [24,34,35].

Globally important agriculture heritage systems are defined as "remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development" [36]. These systems contain important agricultural practices such as low water use, improved soil techniques and protection of natural resources, as well as high levels of biodiversity that contribute to food security and diets [37].

5. What constrains rural places and people?

Many of the poor are smallholder farmers living in rural places. In some places in the world, they are still susceptible to deep issues of hunger and undernutrition [38]. They are also increasingly affected by overweight and obesity. Why is this? Rural populations are often forgotten about due to urban biases [39]. Land parcels are small, access to technologies is limited, and markets are often informal or lacking abundance, perpetuating subsistence livelihoods [40]. Rural areas are often particularly difficult to reach. They are often facing multiple stresses and challenges. Here we focus on five challenges: loss of biodiversity, climate change, urbanization, disempowered women, and conflict.

5.1. Loss of biodiversity

The diversity of food systems and agriculture are rapidly diminishing. The composition of countries' food supplies has become more similar to one another and the global population, as a whole, increasingly rely on a relatively short list of major food crops, such as wheat, rice, sugar, maize and soybeans [41]. There is also a profound loss of variation within major crops due to loss of landraces that are important for smallholder livelihoods, and diversifying risk against climate change and nutrition [42–44].

Some of the reasons for the decreased use of indigenous foods are difficulties in access to land and loss of landraces; perceptions of traditional, indigenous or wild foods as being 'food for the poor'; loss of knowledge on how to use or cook these foods; significant work burden to prepare, process and cook these foods; and poor market demand [42,45,46].

Increased demand for animal source foods is also impacting biodiversity. Extrapolating rates of production and use of land of cattle, pigs, and chickens, Machovina et al., [47] found that the consumption of animal source foods by humans is one of the most powerful negative forces affecting the biological diversity in the world's biodiversity hotspots (which contain 44% of the world's plants and 35% of terrestrial vertebrates) [48]. Due to human activities, the total extent of these hotspots has been reduced by nearly 90% of the original size [48]. This loss was mainly due to the need to expand the agriculture land base over the next 30-plus years.

5.2. Climate change

While climate change models show that yields of crops will decline in some places in the world, it also changes where and which crops can be grown, particularly the global south [49,50]. Climate change also affects the nutritional quality of major crops consumed by the majority of the world due to greenhouse gases (carbon dioxide fertilization effects) with potential risks of decreased content of protein, iron, zinc, and other micronutrient content [51–53]. Climate change is expected to lead to an increased risk of stunting and micronutrient deficiencies due to reduced food availability (as measured in calories available) [54] as well reduced availability of fruit and vegetables and red meat, with large regional variations in the extent of this reduction [55].

5.3. Urbanization and rural isolation

By 2050, an estimated 66% of the world's population will be living in urban centers. Africa and Asia currently remain predominantly rural, with 40% and 48% of their respective populations living in urban areas in 2014 but those regions are urbanizing faster than the rest of the world. By 2050, 56% and 64% of the populations of Africa and Asia respectively will be urban [56].

Urbanization is expected to put additional stress on the food system through increased consumption and demand for a greater diversity of foods. Migration of people from rural areas to cities have led to substantial changes in diet and lifestyle, followed by significant changes to epidemiology – increases in diet-related non-communicable diseases [57]. Urban demand will increasingly dictate what foods are grown by rural producers and how these foods are traded, processed, distributed and marketed, changing the markets for rural producers [58].

Lack of transportation and road infrastructure makes it difficult for smallholders to reach urban markets and leads consumers, especially in cities, to rely more heavily on imported food. This disconnect between rural smallholders and urban markets exacerbates rural poverty.

5.4. Disempowered women

The status of women around the world influences food systems and diets through their biological role in giving birth and breastfeeding, their social role as the primary caregivers for children, as well as their increasingly important role in agriculture [59]. Women's status within the household influences child nutrition through their control of their time and their household income, as well as their self-agency [60–62]. Women are also often responsible for food production in many countries, which creates significant time poverty and physical work burden [63]. With the feminization of agriculture, women are taking on even more tasks, which can have negative impacts on nutrition outcomes [64]. However, access to resources is limited including limited access to and control over land [65].

5.5. Conflict and protracted crises

Many countries are currently struggling with migration, refugees, social unrest and conflict. Because food and nutrition insecurity can be both a cause and a consequence of civil conflict, global chronic undernutrition has become increasingly concentrated in conflict-affected countries [66].

Complex crises have both immediate and long-term consequences for nutritional status [67]. The trigger for crisis may be natural, such as a prolonged drought, or human-made. It may be economic, such as a fluctuation in the price of a country's major staple or cash crop. As well as being a consequence of conflict, food insecurity can also in itself lead to conflict [68], as is the case with rising food prices. Countries that are vulnerable to imported food price volatility may suffer social unrest and conflict when prices rise and governments are unable to intervene [69].

There is also considerable concern about the impacts of human-induced climate change on migration. McMichael [70] indicates that climate change will adversely affect food security in many regions, which may contribute to migration of smallholders out of agriculture. One of the triggers of this migration will be to find food sources that are more secure. However, the movement in the coming decades due to climate change may also lead to more food insecurity in sites of settlement and relocation.

6. How can we address the four challenges faced by rural development have mainstay in our culture?

Rural development is a "strategy to enable a specific group of people, poor rural women and men, to gain for themselves and their children more of what they want and need. It involves helping the poorest among those who seek a livelihood in the rural areas to demand and control more of the benefits of rural development" [71]. If we take stock on the four challenges discussed earlier, what are potential solutions to mitigate these challenges to ensure sustainable rural development in the 21st century?

6.1. Conserving and sustainably using biodiversity

In traditional production systems, farm diversity comes from indigenous and often underutilized agrobiodiversity and forests – the variety of all forms of life directly relevant to agriculture, including

crop varieties and animal species. Agrobiodiversity could influence dietary diversity in traditional food systems because of the increased access to those foods through home gardens, intercropping and mixed systems, and multi-strata forestry systems [21,72–76].

Three areas of innovation can be considered in improving agrobiodiversity for diets in these systems: First, by combining nutritional traits with environmental traits, such as tolerance to drought and salinity, as well as to seasonal availability, farmers can begin to see multiple benefits of their conservation and use [77]. Second, improvements in dietary diversity and quality will only be possible if agrobiodiversity is given attention by agricultural extension services [78]. Third, investing in agricultural R&D may help governments to identify potential policies and programs that could be scaled up to improve production practices [79] and the way food moves through the supply chain, subsequently leading to improvements in diets. There is also a potential to further understand the importance of genetic materials stemming from land races, crop wild relatives and new or rare breeds of animals. International and national seed and gene banks are critical to conserving the genetic materials and should be supported [80]. Although the implications of these increases in productivity may have had the unintended consequence of making highly processed nutrient-poor foods cheaper, investing in R&D for nutrient-rich crops such as fruits and vegetables, and neglected underutilized foods could lead to improvements in productivity, which has the potential to lead to improvements in access to better nutrition.

6.2. Adapting to climate change

There are climate-smart and nutrition-sensitive approaches that can maintain necessary levels of nutritious food production while minimizing the environmental effects of agriculture. Crop and livestock diversity, soil quality and water access increase crop production and nutrition [40]. Crop and livestock diversity also have the potential to increase dietary diversity [40]. Food chain interventions include, for example, increasing irrigation to provide more reliable water for crops, improving soil quality, and increasing diversity of crop varieties and livestock breeds to increase resilience to heat, drought, pests and disease. There is also much that can be done with digital data to provide real-time data to farmers on weather advisories and providing crop insurance to protect against natural disasters [81].

6.3. Feeding urban populations

Smallholder producers in many countries are producing varied and healthy foods that are consumed by urban populations [16]. In order to make the connection between rural producers and urban eaters, new markets need to be created. Smallholders also need bargaining power at markets that can be accomplished by making the demand for products or certain commodities more consistent and reliable, increasing smallholder access to market price information as well as taking actions to stabilize these prices, increasing smallholder participation in decision making, and improving infrastructure centered around processing, storage and roads [82].

There is more evidence that small- and medium-enterprises (SMEs) are sources a lot of the food that urban consumers are eating within more “informal” markets in low- and middle-income countries and transitioning economies [83]. The urban poor consumer is purchasing nutritionally-rich foods such as eggs, meat, fish and milk mainly from informal markets [84]. Strengthening informal markets and the SME actors that are involved could be a mechanism for improving the distribution of healthy foods as well as their safety [85].

With increasing urbanization, there is debate on whether cities should become “food production hubs” such as growing food in greenspaces, rooftops and vertically on buildings [86]. Urban agriculture consists of “small areas within cities, such as vacant lots, verges, shipping containers and balconies, that are used for growing crops and raising small livestock or milk cows for own consumption or sale in neighborhood markets” [87]. A recent analysis of fifteen low- and middle-income country contexts found that 11 to 69% of urban populations engaged in urban agriculture [88]. But there are constraints including insecure land tenure, polluted land and water, and lack of recognition by city authorities. However, further investments in research and data collection are needed to better understand the current and potential contribution of urban agriculture to food security and nutrition outcomes [89].

6.4. Empowering women

For those women living in rural places, by ensuring their rights, data suggest that there are also positive downstream effects on nutritional outcomes [90]. There are key policy interventions aimed at improving nutritional outcomes of women that can be undertaken in the context of women's empowerment [91,92]. They are: (1) increasing household income under women's control to improve overall household well-being (health, nutrition, literacy and wellbeing); (2) ensuring women's access to markets and economic and financial resources; and (3) increasing women's status and change gender roles through developing agency (women's skills and self-worth), challenging power relations and modifying laws and norms that limit women's choices. These interactions facilitate women's rights, improve economic growth and reduce poverty both for women and their household [62].

6.5. Peace and resolution

There is a critical need to enhance the resilience of smallholders through specific policies and programs that link immediate hunger relief interventions with a long-term strategy for improved food security and nutrition. This would include rebuilding local institutions and support networks, ensuring farmers the ability to adapt and reorganize and provide recovery measures for rural livelihoods and supporting vulnerable groups [93].

7. Conclusion

This review attempts to demonstrate the importance of farming systems and farming families that produce the diversity of our food systems and diets. Smallholder farmers are particularly important in supplying the nutrient diversity in the global food supply. Supply answers to demand, and diets are shifting with globalization, urbanization and changes in demographics. Rural societies and development will have to keep up with the rapid changes underway. However, rural populations face challenges. This review focuses on five grand challenges: loss of biodiversity, climate change, urbanization, conflict and women's disempowerment. While the challenges are presented, solutions are as well. There are actions that can be taken now and into the future to ensure that rural populations continue to play an important role in feeding the world, and feeding it well.

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Number of countries included are shown in parentheses. Country regional and income groupings are the same used by the World Bank. Only 161 of 167 countries with observations are classified by the World Bank. Source: Lowder et al. [13].

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